

# Satellite Remote Sensing

Bouteiller Lisa, Paco Lardy–Nugues, Hugo Feidt, Pauline Boudy

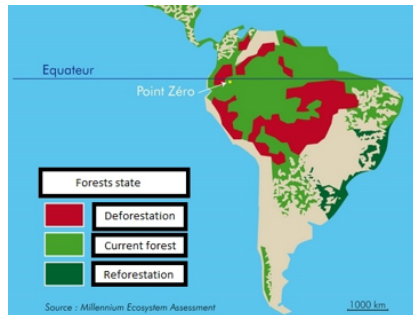
May 2023

# Contents

- 1 Presentation of our project
- 2 Download satellite data
- 3 RGB band : Application of a mask
- 4 RGB band : Gradient
- 5 Chlorophyll : Threshold and Gradient
- 6 Conclusion and future objectives

# Presentation of our project

Quantification of deforestation in the *Amazon* Rainforest as a first step by comparing images from different years.



## Causes of this deforestation :

- ① Logging (forestry company)
- ② Intensive agriculture and livestock farming
- ③ Road construction and urban expansion

Source : [zero-deforestation.org](http://zero-deforestation.org)

# Download satellite data

## Website *Copernicus*

Satellite Platform

S2A\_\*



Relative Orbit Number (from 1 to 143)

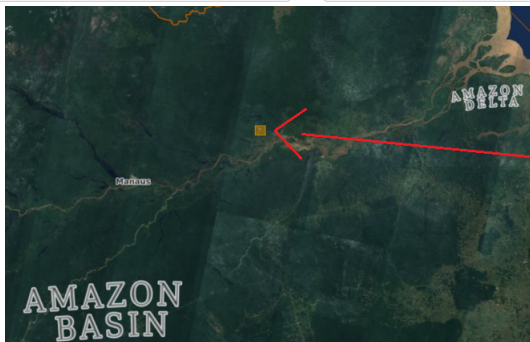
Product Type

S2MSI2A



Cloud Cover % (e.g.[0 TO 9.4])

[0 TO 1]



Logging

## Download satellite data

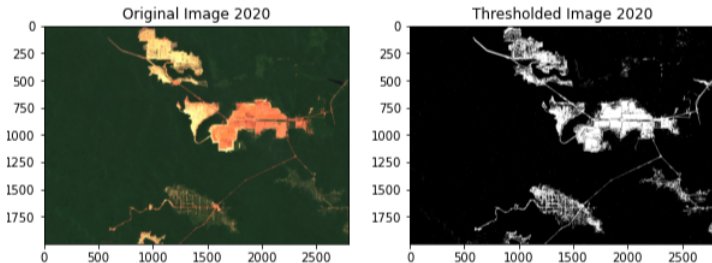
Website *EarthExplorer* - American satellites

The screenshot displays the Earth Explorer web application interface. On the left, the 'Data Set' dropdown is set to 'Landsat 8-9 OLI/TIRS C2 L1'. Below this, a pagination bar shows '1' of 6 pages. The main results pane displays a list of search results, each with a thumbnail, ID, Date Acquired, Path, and Row. The first result is LC08\_L1TP\_229061\_20181124\_20200830\_02\_T1, acquired on 2018/11/24, Path: 229, Row: 061. The second result is LC08\_L1TP\_228061\_20181101\_20200830\_02\_T1, acquired on 2018/11/01, Path: 228, Row: 061. The third result is LC08\_L1TP\_229061\_20181023\_20200830\_02\_T1, acquired on 2018/10/23, Path: 229, Row: 061. The fourth result is LC08\_L1TP\_229061\_20181007\_20200830\_02\_T1. At the bottom of the results pane are buttons for 'View Item Basket' and 'Submit Standing Request'. On the right, a map shows the search area over a river delta region, with a red rectangle indicating the selected search area. The map includes labels for 'Urucará', 'Parintins', 'Lacustaria', and 'Maués'.

This allows us to have data before 2019.

## Application of a mask

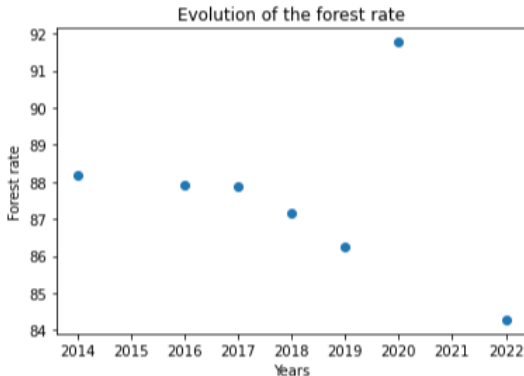
The goal : count the number of the pixels of the forest.



$$NDVI_{green\&blue} = \frac{\rho_{blue} - \rho_{green}}{\rho_{blue} + \rho_{green}}.$$

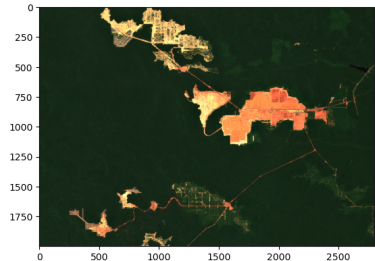
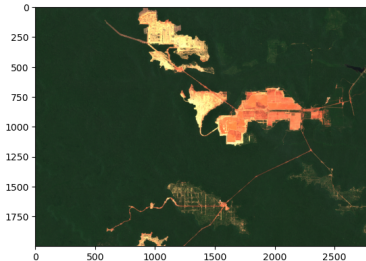
## Results

From 2014 to 2022, we can count the number of the black pixels that we divide by the total number of pixels. We obtain this graph :



## Realization of the Gradient

To quantify the evolution of the deforestation between two years, we calculate a time gradient : it is the difference between each pixels of these images.

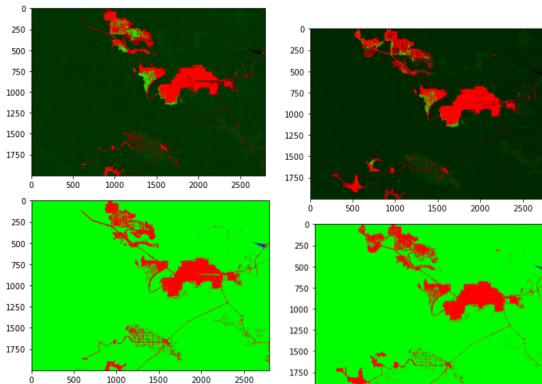


Images for 2020 and 2022.



## Realization of the Gradient

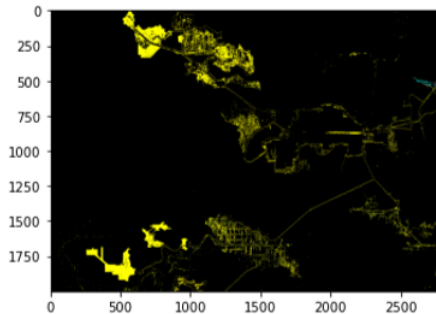
Obtained images with a pre-treatment :



We have kept the most intense pixel and removed the clouds.

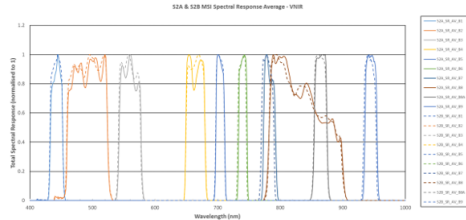
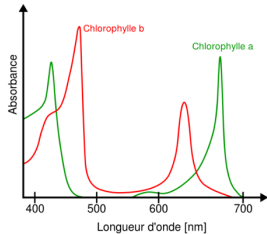
## Results

Then, we applied the time gradient :



The yellow areas are the extension of the logging. This represents 3.7% of the deforestation between 2020 and 2022.

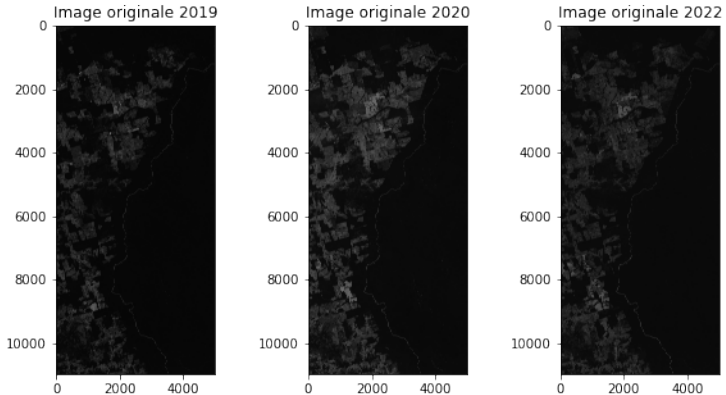
# Chlorophyll



Sources : researchgate.net and datasheet Sentinel-2

2 absorption bands in the visible range for chlorophyll : detectable by *Sentinel 2*.

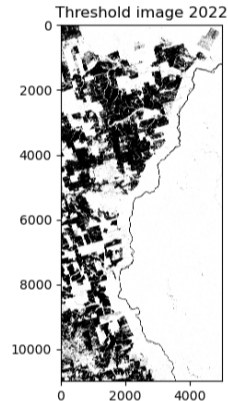
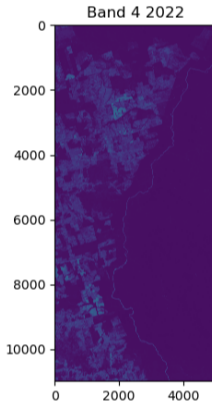
## Images for the chlorophyll



These images are those of the satellite *Sentinel 2*.

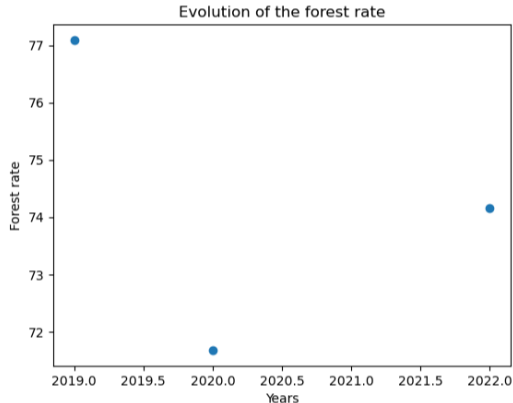
## Chlorophyll data exploitation : Threshold

We applied a thresholding on this image to distinguish the two areas :



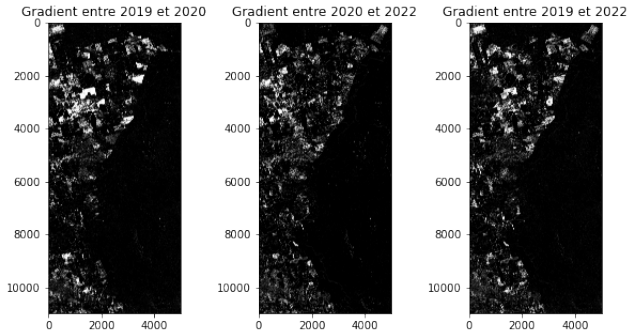
## Chlorophyll data exploitation : Mask

We obtained this evolution of the forest :



## Chlorophyll data exploitation : Gradient

Then, we can apply a gradient to compare :



The evolution of the deforestation is around 6.3% between 2020 and 2022.

## Conclusion on our results

With the images in RGB and those with the chlorophyll, we obtained some similar results.

	RGB Image	Image of the Chlorophyll
between 2020 and 2022:	increase in deforestation by 3.7%	6.3%
	In 2020, the forest rate increases	
	Otherwise between 2014 and 2022, the forest rate decreases	

Accuracy between the two methods: the gradient method threshold depends of each image so the method of the gradient is more precise.



## Future objectives

- ① Average over the pixels for the threshold.
- ② Program to remove the clouds regardless of the image used.
- ③ Extend to the entire Amazon and then to all the forests the quantification of the forest.
- ④ Maybe programs to count the number of the trees.